

REMARKS

Claims 1-20 are pending in the present application. Claims 12-20 are withdrawn from consideration. Claims 1-11 are rejected. Claims 1 and 10 are herein amended. No new matter has been entered.

Claims 1-11 are rejected under 35 U.S.C. §103(a) as being unpatentable over Nakano et al. (US Patent No. 6,680,540) in view of Miyamoto et al. (US Patent No. 6,670,714).

The Examiner focuses on the multi-level interconnection structure disclosed in FIGs. 5 and 7(a)-7(h) of Nakano et al. The Examiner argues that the insulation film 18 and the etch stop layer 19 in the lower part of the multi-level interconnection structure correspond to the first low dielectric constant film and the hydrophilic insulation film of the present invention according to claim 1, respectively. The Examiner argues that the insulation film 18 and the barrier film 3 in the middle part of the multi-level interconnection structure correspond to the second low dielectric constant film and the diffusion preventing film of the present invention according to claim 1, respectively.

Applicants herein amend claims 1 and 10 to more clearly recite the invention. Thereafter, Applicants submit that the cited references, alone or in proper combination, fail to teach or suggest all of the claimed limitations in the invention.

Applicants submit that Nakano et al. fails to teach the structural feature of the present invention according to claim 1, only disclosing the multi-level interconnection structure in which

the lower part, the middle part and the upper part have the same insulation structure comprising the insulation film 18, the etch stop layer 19 and the barrier film 3.

Applicants note that the invention according to claim 1 is characterized as having characteristically different insulation films formed on low dielectric constant films according to pitches of interconnection layers, which are buried in the low dielectric constant films. That is, the hydrophilic insulation film is formed on the first low dielectric constant film in which a first interconnection layer having a smaller minimum pitch is buried, while the diffusion preventing film is formed directly on the second low dielectric constant film in which a second interconnection layer having a larger minimum pitch is buried. By selectively using the hydrophilic insulation film or the diffusion preventing film according to the pitches of the interconnection layers, when low-dielectric constant films are used as inter-layer insulation films, the first interconnection layer can suppress the occurrence of defects and the decreases the interconnection capacitance, while the second interconnection layer can sufficiently decrease the interconnection capacitance, corresponding to functions of the interconnections.

On the other hand, Nakano et al. merely teaches the formation of the same insulation film on the low dielectric constant film in which the interconnection layer is buried. That is, in all of the lower part, the middle part and the upper part of the multi-level interconnection structure of FIG. 5, the etch stop layer 19 is formed on the insulation film 18. No variety of insulation films formed on the low dielectric constant film according to the pitch of the interconnection layer can be found in Nakano et al. It is apparent that Nakano et al. fails to teach or suggest the

relationship between the pitches of interconnections and physical properties or materials of the inter-layer insulation films.

Furthermore, Miyamoto et al. also fails to teach or suggest the relationship between the pitches of interconnections and physical properties or materials of the inter-layer insulation films. Miyamoto et al. only teaches a multi-level interconnection structure including interconnections with different pitches, the pitches having completely nothing to do with choice of an insulation film formed on a low dielectric constant film.

In addition, the barrier film 3 of Nakano et al. does not correspond to the diffusion preventing film of the present invention according to claim 1. The diffusion preventing film of the present invention is directly formed on the upper surfaces of the second low dielectric constant film and the second interconnection layer. In the present invention, there is no hydrophilic insulation film between the diffusion preventing film and the upper surfaces. On the other hand, the barrier film 3 of Nakano et al. is formed on the side and bottom surfaces of the trench in which the interconnection layer is buried. Thus, the barrier film 3 is formed neither on the upper surface of the low dielectric constant film nor the upper surface of the interconnection layer. It is clear that the diffusion preventing film of the present invention is formed in a different manner from that the barrier film 3 of Nakano et al. is formed in.

As noted above, Nakano et al. does not disclose the structural feature of the present invention that the different insulation films are formed on the low dielectric constant films in the multi-level interconnection, as well as not explicitly stating any size relationship between pitches of interconnection layers. Accordingly, even if properly combined, the combined teachings of

the Nakano et al. and Miyamoto et al. merely lead to a multi-level interconnection structure having interconnection layers of different pitches with the same insulation structure comprising the insulation layer 18, the etch stop layer 19 and the barrier film 3. The combination of the teachings never suggests the structural feature of the present invention according to claim 1.

The present invention according to independent claim 10 has the same structural feature as that of claim 1 in connection with the first inter-layer insulation film and the second inter-layer insulation film. Therefore, the same discussion regarding to claim 1 mentioned above is applied to the rejection of claim 10.

As discussed herein, Applicants submit that the present invention according to claims 1 and 10 would have been unobvious to one of ordinary skill in the art at the time the invention was made even if Nakano et al. were combined with Miyamoto et al. Furthermore, because claims 2-9 and 11 depend from claims 1 and 10 and necessarily include at least their limitations, Applicants submit that the dependent claims are similarly non-obvious.

In view of the aforementioned amendments and accompanying remarks, Applicants submit that the claims, as herein amended, are in condition for allowance. Applicants request such action at an early date.

If the Examiner believes that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned attorney to arrange for an interview to expedite the disposition of this case.

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If this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees that may be due with respect to this paper may be charged to Deposit Account No. 50-2866.

Respectfully submitted,

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